

WHAT IS CLAIMED IS:

1                   1.       A leakage detecting method for use in an oxidizing system of forming  
2 an oxide layer, the method comprising the steps of:

3                   (a) providing an oxidizing system having an oxidizing chamber and an oxygen  
4 concentration analyzer installed in a bypass of an exhaust pipe of said oxidizing chamber;

5                   (b) performing an oxidizing process on a test wafer in a test run under a  
6 specified operating condition in said oxidizing system by flowing an oxidizing gas through  
7 said oxidizing chamber containing said test wafer;

8                   (c) measuring an oxygen concentration of said oxidizing gas exiting said  
9 oxidizing chamber in said test run by said oxygen concentration analyzer;

10                  (d) measuring the oxide thickness of said test wafer after said test run;

11                  (e) repeating (b), (c), and (d) for a plurality of test runs to obtain a correlation  
12 between the measured oxygen concentration and the oxide thickness for the plurality of test  
13 runs to identify an acceptable oxygen concentration corresponding to a maximum acceptable  
14 oxide thickness, wherein an oxygen concentration greater than said acceptable oxygen  
15 concentration indicates gas leakage in said oxidizing system;

16                  (f) selecting a safety factor and multiplying said acceptable oxygen  
17 concentration with said safety factor to get a threshold oxygen concentration;

18                  (g) performing a general oxidizing process on a working wafer under said  
19 specified operating condition in said oxidizing system; wherein while said oxygen  
20 concentration analyzer starts to measure an oxygen concentration of said oxidizing gas  
21 exiting said oxidizing chamber, if said measured oxygen concentration is greater than said  
22 threshold oxygen concentration, an indication of gas leakage exists in said general oxidizing  
23 system.

1                   2.       The method of claim 1 wherein said maximum acceptable oxide  
2 thickness is about 20 Å.

1                   3.       The method of claim 1 wherein said specified operating condition  
2 comprises a temperature from about 700 °C to 1200 °C and an oxidizing time period from  
3 about 10 to 20 minutes.

1                   4.       The method of claim 1 wherein said safety factor is about 0.9.

1                   5.       The method of claim 1 further comprising introducing an inert gas into  
2 said oxidizing system to purge said oxidizing system prior to performing said oxidizing  
3 process.

1                   6.       The method of claim 5 wherein said inert gas comprises nitrogen.

1                   7.       The method of claim 1 further comprising at least one action of re-  
2 tightening one or more connectors and welding one or more pipes in said oxidizing system,  
3 upon detecting a gas leakage in said oxidizing system when said measured oxygen  
4 concentration is greater than said threshold oxygen concentration.

1                   8.       The method of claim 1 further comprising ascertaining that there is no  
2 gas leakage in said oxidizing system when the measured oxygen concentration is lower than  
3 said threshold oxygen concentration, and performing an oxidizing process on at least one  
4 working wafer under said specified operating condition in said oxidizing system to form the  
5 oxide layer on said working wafer.

1                   9.       A method for estimating a thickness of an oxide layer formed on a  
2 wafer, the method comprising:

3                   providing an oxidizing system having an oxidizing chamber for forming an  
4 oxide layer on one or more substrates by flowing an oxidizing gas through said oxidizing  
5 chamber;

6                   placing a working wafer in said oxidizing chamber of said oxidizing system;  
7                   performing an oxidizing process on said working wafer under a specified  
8 operating condition to form an oxide layer on said working wafer by flowing said oxidizing  
9 gas through said oxidizing chamber;

10                  measuring an oxygen concentration of said oxidizing gas exiting said  
11 oxidizing chamber; and

12                  estimating a thickness of said oxide layer according to said measured oxygen  
13 concentration and a previously determined relation between oxide layer thicknesses formed  
14 on test substrates placed in said oxidizing chamber and oxygen concentrations of gases  
15 exiting said oxidizing chamber in test runs of oxidizing processes performed on the test  
16 substrates under said specified operating condition.

1                   10.     The method of claim 9 wherein the previously determined relation is  
2     obtained by:

3                   performing oxidizing processes on a plurality of test wafers in a plurality of  
4     test runs under said specified operating condition in said oxidizing system to form oxide  
5     layers on the test wafers having a plurality of oxide thicknesses for the plurality of test runs  
6     by flowing said oxidizing gas through said oxidizing chamber containing said test wafers;

7                   measuring an oxygen concentration of said oxidizing gas exiting said  
8     oxidizing chamber in each of said plurality of test runs; and

9                   obtaining the relation between said measured oxygen concentrations and the  
10    oxide thicknesses for the plurality of test runs to identify a threshold oxygen concentration  
11    corresponding to a maximum acceptable oxide thickness, wherein an oxygen concentration  
12    greater than said threshold oxygen concentration indicates gas leakage in said oxidizing  
13    system.

1                   11.     The method of claim 10 wherein said maximum acceptable oxide  
2     thickness is about 20 Å.

1                   12.     The method of claim 9 wherein said specified operating condition  
2     comprises a temperature from about 700 °C to 1200 °C and an oxidizing time period from  
3     about 10 to 20 minutes.

1                   13.     The method of claim 9 further comprising, prior to placing a working  
2     wafer in said oxidizing chamber, performing a checking procedure to ascertain that there is  
3     no leakage in said oxidizing system according to said previously determined relation between  
4     oxide layer thicknesses formed on test substrates placed in said oxidizing chamber and  
5     oxygen concentrations of gases exiting said oxidizing chamber.

1                   14.     The method of claim 13 wherein performing a checking procedure  
2     comprises:

3                   placing a working wafer in said oxidizing chamber of said oxidizing system;  
4                   performing an oxidizing process on said working wafer under said specified  
5     operating condition to form an oxide layer on said working wafer by flowing said oxidizing  
6     gas through said oxidizing chamber;

7                   measuring an oxygen concentration of the oxidizing gas exiting said oxidizing  
8     chamber; and

9                   determining whether there is gas leakage in said oxidizing system by  
10 comparing said measured oxygen concentration with said threshold oxygen concentration  
11 multiplied by a safety factor, wherein there is no gas leakage in said oxidizing system when  
12 said measured oxygen concentration is lower than said threshold oxygen concentration  
13 multiplied by said safety factor.

1                   15.     The method of claim 14 wherein said safety factor is about 0.9.

1                   16.     The method of claim 14 further comprising introducing an inert gas  
2 into said oxidizing system to purge said oxidizing system prior to performing said oxidizing  
3 process on said working wafer.

1                   17.     The method of claim 16 wherein said inert gas comprises nitrogen.

1                   18.     The method of claim 9 wherein said oxygen concentration of said  
2 oxidizing gas exiting said oxidizing chamber is measured by an oxygen analyzer disposed  
3 downstream of said oxidizing chamber.